Chapter 3
Science and Engineering Workforce

Contents

Highlights

Labor Market Conditions

- **Overall labor market conditions were similar in 1993 and 1995, despite many changes in conditions for specific S&E fields.** Overall unemployment rates for science and engineering (S&E) Ph.D.-holders went from 1.6 percent to 1.5 percent. For recent Ph.D. recipients, the unemployment rate grew from 1.7 to 1.9 percent.
- **Only 2.4 percent of recent S&E Ph.D. recipients reported working in a non-S&E job that was unrelated to their field.** Based on the proportions reporting that they were involuntarily working outside of their field, the disciplines in which recent Ph.D. graduates found it most difficult to locate in-field employment in 1995 were political science (11.2 percent); mathematics (9.3 percent); sociology/anthropology (9.1 percent); earth, atmospheric, and oceanographic sciences (6.8 percent); and physics (6.7 percent). The biological sciences fared better, with 2.8 percent reporting involuntary outside-of-field employment; other measures, however, suggest a drop in the availability of tenure-track positions for recent biological sciences graduates.
- **Most holders of Ph.D.s in science and engineering do not work in academia.** Only 28.4 percent are employed as postsecondary teachers, and another 15.5 percent have some other employment at a four-year educational institution.
- **Only 12.1 percent of scientists and engineers in postdoctoral positions in 1993 were in tenure-track positions in 1995; 41.6 percent still held postdoctorate appointments.** Nevertheless, the length of time spent in postdoctoral positions appears to be only slightly greater than that reported retrospectively by those in mid-career.
- **While most individuals in postdoctorate positions in 1995 reported additional training and other customary reasons for accepting their appointments, 17.1 percent said that they had taken a postdoctorate because other employment was not available.** This proportion rises to 29.3 percent for the earth, atmospheric, and oceanographic sciences and to 26.8 percent for physics.

Characteristics of the S&E Workforce

- **Almost 3.2 million people with a bachelor's degree or higher were employed in an S&E occupation in 1995.** Engineers represented 42 percent (1.34 million) of all those in S&E occupations, followed by computer and math scientists with 30 percent (950,000) of the total. Physical scientists accounted for less than 10 percent of the S&E workforce in 1995.
- **The pattern of S&E degree production at each degree level over the last 50 years—rapid growth followed by a recent slowdown—creates a likely demographic pattern in the S&E labor force with several implications.** First, the number of scientists and engineers nearing traditional retirement ages will increase steadily and dramatically over the next 25 years. Second, even if there is no growth in the number of new S&E degree recipients, the size of the S&E-trained labor force will continue to increase for some time as the number of new entrants exceeds retirements and deaths. Finally, if degree production grows at a slower rate than in the past, the average age of scientists and engineers in the labor force will increase—with mixed implications for different aspects of research productivity.

International Context

- **A lower bound estimate of U.S. native-born S&E Ph.D. graduates living abroad is 13,900—3.3 percent of all such Ph.D. recipients.** If foreign-born doctoral recipients with U.S. citizenship or permanent residency at the time of their degrees are included, this figure rises to 19,600 (4.1 percent of the total).

Projected Demand

- **During the 1996-2006 period, employment in S&E occupations is expected to increase at more than three times the rate for all occupations.** While the economy as a whole is anticipated to provide approximately 14 percent more jobs over this decade, employment opportunities for S&E jobs are expected to increase by about 44 percent or about 1.36 million jobs.

Introduction

Chapter Overview

Scientists and engineers play vital roles in the technological performance of U.S. industry in such areas as product or process innovation, quality control, and productivity enhancement. In addition, they conduct basic research to advance the understanding of nature, perform research and development (R&D) in a variety of areas such as health and national defense, train the nation's future scientists and engineers, and improve the scientific and technological literacy of the nation.

In the early 1990s, the U.S. science and engineering (S&E) workforce faced new and different challenges from those it experienced in the 1980s. A sluggish recession recovery, cutbacks in defense-related spending, reduced R&D budgets, and industry downsizing slowed the growth of S&E employment. Manufacturing S&E employment declined for the first time in more than a decade, while unemployment rates rose. Despite these trends, scientists and engineers have fared better than almost any other kind of worker. Moreover, the tight labor market has not precluded some S&E-trained individuals from finding meaningful, challenging work opportunities outside traditional S&E occupations.

Chapter Organization

This chapter first examines labor market conditions for recent bachelor's, master's, and doctoral S&E degree recipients. Information on the sex and racial/ethnic composition of the S&E workforce is next presented, followed by a description of S&E job trends in the service sector. The chapter provides data on foreign-born scientists and engineers, and presents comparisons regarding international R&D employment. It concludes with a brief section on the projected demand for S&E workers over the 1996-2006 decade.

Labor Market Conditions for Recent S&E Degree-Holders

Bachelor's and Master's Degree Recipients[1]

Recent S&E bachelor's and master's degree recipients are a key component of the nation's science and engineering workforce: they account for almost half of the annual inflow to the S&E labor market (NSF 1990, p. 40). The career choices of recent graduates and their entry into the labor market affect the balance between the supply of and demand for scientists and engineers in the United States. Analysis of the workforce status and other characteristics of recent S&E graduates can yield valuable labor market information. This section provides several labor market measures, including median annual salaries and in-field employment rates, that offer useful insights into the overall supply and demand conditions for recent S&E graduates in the United States.

Median Annual Salaries

In 1995, the highest median annual salaries of recent college graduates employed full time were earned by those with engineering degrees. The median annual salary for graduates with a bachelor's degree in engineering was $33,500; it was $44,000 for those with a master's degree. (See appendix table 3-1.) When compared with the salaries for recent science graduates with bachelor's degrees ($22,900) and master's degrees ($35,000), it is apparent that choice of a college major may significantly affect the salaries of recent college graduates entering the labor market.

School Versus Employment

About one out of four recent S&E bachelor's and master's degree recipients was enrolled in graduate school on a full-time basis in 1995. Students who had majored in the physical and life sciences were more likely to be going on to graduate school as full-time students than were those with degrees in mathematics and the computer sciences or engineering.

In-Field Employment

Success in the job market varies significantly by level and field of degree. One measure of success is the likelihood of finding employment directly related to a graduate's field of study. S&E master's degree recipients were more likely than bachelor's graduates to find work directly related to their field of study. Approximately one-half of all master's S&E degree recipients—but only a fifth of all S&E bachelor's recipients—were employed in their field of study in 1995. Among both master's and bachelor's degree recipients, students who had received their degrees in either engineering or the computer sciences were more likely to be working in their field of study. Students majoring in the social sciences were less likely to have jobs directly related to their degrees.

Employment Sectors

The private sector is by far the largest employer of recent bachelor's and master's degree recipients. In 1995, 59 percent of bachelor's degree recipients and 47 percent of master's degree recipients were employed in a private for-profit company. (See appendix table 3-2.) The academic sector is the second largest employer of recent S&E graduates. Master's degree recipients were more likely to be employed in four-year colleges and universities (23 percent) than were bachelor's degree recipients (13 percent). The federal sector employs only 7 percent of S&E master's degree recipients and 4 percent of S&E bachelor's degree recipients. Engineering graduates are more likely than science graduates to find employment in the federal sector. Sectors employing smaller numbers of recent

[1]Data in this section are taken from the 1995 National Survey of Recent College Graduates. This survey collected information on the 1995 workforce/other status of 1993 and 1994 bachelor's and master's degree recipients in S&E fields. Surveys of recent S&E graduates have been conducted biennially for the National Science Foundation since 1978. For information on standard errors associated with survey data, see NSF (1997b).

S&E graduates include educational institutions other than four-year colleges and universities, private nonprofit organizations, and state or local government agencies.

Doctoral Degree Recipients

Concerns have been raised about labor market opportunities for new Ph.D. scientists and the possible consequences on the health of scientific research in the United States.[2] Several recent developments have contributed to these concerns, including demographic changes (which have slowed the growth in undergraduate enrollment), reductions in defense and research funding, growth in the importance of Ph.D. programs at foreign schools (see chapter 2, "Worldwide Increase in S&E Educational Capabilities"), and rates of Ph.D. production that approach or exceed the high levels realized at the end of the Vietnam draft.

Since the 1950s, the Federal Government has actively encouraged graduate training in science through a number of mechanisms. However, widespread unemployment or involuntary movement out of S&E by large numbers of new Ph.D. scientists and engineers could have various adverse effects on the health of scientific research in the United States. If labor market difficulties are real but temporary, promising students may be discouraged from pursuing degrees in S&E fields. Eventually, this circumstance could reduce the ability of industry, academia, and government to perform R&D. If labor market difficulties are long term, restructuring will need to take place within graduate education and federal research support to maintain quality research. In either case, when much high-level human capital goes unused, society loses potential opportunities for new knowledge and economic advancement—and individuals feel frustrated in their careers.

Aggregate measures of labor market conditions for recent Ph.D. recipients (one to three years since degree) changed only slightly between April 1993 and April 1995.[3] The unemployment rate for all recent Ph.D. recipients rose from 1.7 percent in 1993 to 1.9 percent in 1995. (See text table 3-1.) The rate of recent Ph.D.s involuntarily working outside of their degree fields rose slightly, from 4.0 percent in 1993 to 4.3 percent in 1995. These aggregate numbers mask much larger changes in labor market conditions—both positive and negative—within individual disciplines.

Most individuals who complete an S&E doctorate are looking for more than just steady employment at a good salary. Their technical and problem-solving skills make them highly employable, but the opportunity to do the type of work they want and for which they have been trained is important to them. For that reason, no single measure can well describe the S&E labor market. Some of the available labor market indicators are discussed below.

Unemployment Rates

Only 1.9 percent of recent (one to three years after degree award) Ph.D. recipients were unemployed in April 1995.[4] (See text table 3-1.) This number is low compared to the 5.7 percent unemployment rate for all civilian workers, and is only slightly higher than the 1.5 percent rate for S&E doctoral recipients. In several fields, however, new Ph.D.s faced higher unemployment rates: 4.3 percent in chemical engineering, 4.0 percent in mathematics, 3.2 percent in sociology/anthropology, and 2.9 percent in physics. While still much lower than for the general population, these unemployment rates are unusually high for a highly skilled group. For recent physics Ph.D.s, however, the 2.9 percent rate represents a large drop from the 5.3 percent unemployment rate reported by the 1993

[2]For a more detailed discussion, see COSEPUP (1995).

[3]This section primarily uses data from the 1993 and 1995 Survey of Doctorate Recipients (SDR), a biennial National Science Foundation (NSF) survey of doctorate-holders from U.S. institutions up to age 75; and the closely related Scientists and Engineers Statistics Data System (SESTAT) integrated file which contains data from the SDR and two other NSF surveys, the National Survey of College Graduates and the National Survey of Recent College Graduates. For more informaiton on SDR, see chapter 5, "Data Sources: Nature, Problems, and Comparability."

[4]People are said to be unemployed if they were not employed during the week of April 15, 1995, and had either looked for work during the preceding four weeks or were on layoff from a job.

Text table 3-1.
Labor market rates for recent Ph.D.s, by degree field
(Percentages)

Ph.D. degree field	Unemployed		Involuntary out-of-field employment	
	1993	1995	1993	1995
All S&E	1.7	1.9	4.0	4.3
Life sciences	0.9	2.0	2.6	2.6
Agricultural sciences	1.1	1.1	2.7	2.2
Biological sciences	0.7	2.2	2.3	2.8
Health/medical sciences	1.5	1.3	2.1	2.2
Math and computer sciences	1.1	2.6	4.9	6.2
Mathematics	0.7	4.0	7.1	9.3
Computer sciences	1.5	1.1	2.1	2.7
Physical sciences	3.0	2.4	5.4	5.3
Chemistry	1.6	2.1	4.0	4.1
Earth, atmospheric & oceanographic	3.4	1.7	8.5	6.8
Physics	5.3	2.9	6.1	6.7
Social sciences	1.8	1.4	4.6	5.5
Economics	2.1	1.4	4.1	2.7
Political science	2.4	2.5	5.1	11.2
Psychology	1.4	0.5	2.2	3.8
Sociology/anthropology	3.3	3.2	11.6	9.1
Engineering	1.9	1.7	3.7	3.7
Chemical	1.1	4.3	2.1	3.3
Civil	1.9	1.3	1.4	1.0
Electrical	1.9	0.9	3.8	3.0
Mechanical	1.3	2.8	8.3	5.0

NOTE: Recent Ph.D.s are those who received their degrees one to three years previously.

SOURCE: National Science Foundation, Science Resources Studies Division, Survey of Doctorate Recipients, merged 1993 and 1995 files. *Science & Engineering Indicators – 1998*

cohort. On the other hand, the rates for mathematics and chemical engineering are notably greater than the negligible 0.7 and 1.1 percent rates reported respectively in 1993.

Involuntarily Working Outside of Field

Another 4.3 percent of recent S&E Ph.D. recipients in the labor force reported that they could not find full-time employment "closely related" or "somewhat related" to their degrees. These persons are considered to be IOF—involuntarily out-of-field. This definition of IOF includes those working part time in their fields because full-time work was not available.

As with unemployment, IOF rates varied greatly by field, with 11.2 percent in political science; 9.3 percent in mathematics; 9.1 percent in sociology/anthropology; 6.8 percent in earth, atmospheric, and oceanographic sciences; and 6.7 percent in physics. (See text table 3-1.) Fields with relatively low IOF rates for recent Ph.D.s included 1.0 percent in civil engineering, 2.2 percent for both agricultural and medical sciences, 2.7 percent for both economics and computer sciences, and 2.8 percent in the biological sciences.

Tenure-Track Positions

Most S&E Ph.D. recipients do not work in academia. (See "How Traditional Is an Academic Career?"; but also see chapter 5, "The Academic Doctoral S&E Workforce.") Across all fields and ages, only 30.8 percent of S&E Ph.D.s in the labor force are in tenure-track or tenured positions at four-year educational institutions. (See text table 3-2.) Across fields, academic tenure-track employment varies from a high of 54.0 percent for economics to a low of 14.0 percent for chemical engineering. Still, the availability of tenure-track positions is an important aspect of the job market for those who do seek academic careers.

In 1995, 15.9 percent of recent S&E Ph.D. recipients were in tenure-track positions. (See text table 3-2.) This proportion rose to 26.8 percent among those who had received their doctorates within the previous four to six years; it was greater still (30.5 percent) for those at mid-career—11 to 20 years after degree. The percentage of Ph.D.s with tenure-track positions does not, however, reveal much about how difficult it is to obtain academic employment—in fields where many new Ph.D.s prefer employment in industry, there may actually be less competition for academic jobs.

Comparable historical data on tenure-track rates in early career are not available, but comparisons with mid-career tenure-track rates do provide an imperfect indicator of changes in the availability of academic positions. By this relative measure, early career tenure-track rates (four to six years out) are noticeably lower in the biological sciences (–14.4 percentage points), agriculture (–10.1), chemical engineering (–8.6), and physics (–4.7).

The differences in tenure-track rates in the biological sciences are a notable part of a complicated labor market profile for that field. Both unemployment and IOF rates are relatively low in the biological sciences. However, salaries are also lower—and, evidently, so are the opportunities for tenure-track academic employment.

Relationship Between 1995 Occupation and Degree Field

By a strict definition of occupational titles, 31.5 percent of employed recent Ph.D.s were in occupations outside science and engineering, often with administrative or management functions. When asked how related their jobs were to their highest degree, only a small proportion of recent Ph.D.s in non-S&E occupations said that their jobs were unrelated to their degree. (See text table 3-4.) By field, these respondents ranged from 1.5 percent of recent engineering Ph.D. graduates to 4.5 percent of recent Ph.D. graduates in mathematics and the computer sciences.

Changes in Employment Status

Of the 72.2 percent of recent S&E Ph.D. recipients who were in "regular" employment in 1993 (that is, not in a postdoctorate appointment and not involuntarily working outside of their fields), the vast majority—94 percent—were still in regular employment in 1995. (See figure 3-1.) Of those in other 1993 employment statuses (postdoctorate, IOF, or unemployed), 50 percent of each group had moved to regular employment by 1995. Forty-five percent of 1993

Text table 3-2.
Scientists and engineers holding tenure and tenure-track appointments at four-year institutions, by degree field and years since Ph.D. award: 1995
(Percentages)

Ph.D. degree field	Early career 1-3 years	Early career 4-6 years	Mid-career 11-20 years	Mid-career All years
All S&E	15.9	26.8	30.5	30.8
Agricultural sciences	13.4	26.0	36.1	32.8
Biological sciences	8.8	19.8	34.2	32.5
Health/medical sciences	32.5	45.2	37.9	39.0
Mathematics	36.0	52.7	51.3	53.5
Computer sciences	34.5	42.3	38.9	40.9
Chemistry	6.9	14.6	15.1	18.8
Earth, atmospheric & oceanographic sciences	10.9	30.1	27.3	28.8
Physics	5.8	15.6	20.3	23.5
Economics	42.4	55.4	52.2	54.0
Political science	29.5	68.4	51.6	52.7
Psychology	13.1	19.8	19.8	22.1
Sociology/anthropology	32.2	50.4	49.2	49.9
Chemical engineering	6.6	6.0	14.6	14.0
Civil engineering	25.5	29.9	33.7	34.5
Electrical engineering	10.8	22.5	26.4	22.9
Mechanical engineering	14.4	26.3	24.2	23.3

SOURCE: National Science Foundation, Science Resources Division, 1995 Survey of Doctorate Recipients.

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How Traditional Is an Academic Career?

It has long been known from the Survey of Doctorate Recipients (SDR) and other labor force surveys that a large majority of doctorate level scientists and engineers, at any one point in time, work outside academia. The 1995 Scientists and Engineers Statistics Data System (SESTAT) Work History Module, combined with the 1995 SDR core questions, provides current and retrospective career information that allows mapping of typical career paths.

Text table 3-3 divides the population of employed S&E doctorate-holders into four groups: those currently employed as postsecondary teachers, those currently in nonteaching jobs at four-year institutions, those who were formerly postsecondary teachers at some time after completion of their Ph.D.s, and those not currently employed in academia and who reported no postsecondary teaching positions since completion of their Ph.D.s. (Note that tenured administrators and other nonteaching faculty make up most of the difference between the percentage in postsecondary teaching positions and those with tenure or in tenure-track positions; also note that many nonteachers employed in academia also report being former postsecondary teachers.) One weakness of this analysis based on occupation is that it does not capture the past academic affiliations of scientists and engineers who are hired as administrators or researchers without ever being part of the teaching faculty.

A small majority—53.3 percent—of employed S&E doctorate-holders in 1995 were either currently in academia or reported past employment as postsecondary teachers since receiving their degrees. There is less academic involvement in engineering and the physical sciences, where majorities report never having been employed as postsecondary teachers or having no current employment in academia. It is also noteworthy that even in mathematics and the computer sciences, where employment in academia is heaviest, a large majority of currently nonacademic scientists and engineers appears never to have held academic teaching jobs. This view is consistent with shorter career views obtained by longitudinal matching of the SDR data; these data show relatively little movement between academia and industry, excluding new graduates and postdoctorates.

Text table 3-3.
Current or former employment of S&E Ph.D.s as postsecondary teachers, by field: 1995
(Percentages)

Ph.D. degree field	Current postsecondary teacher	Current nonteaching employment at 4-year institution	Former postsecondary teacher	Never postsecondary teacher
All S&E	28.4	15.5	9.4	46.7
Life sciences	25.7	23.8	6.9	43.6
Math and computer sciences	48.5	9.4	11.7	30.4
Physical sciences	22.6	14.6	8.5	54.3
Social sciences	35.6	11.6	12.6	40.1
Engineering	20.3	10.9	8.4	60.4

NOTE: Data are for those employed as of April 1995.

SOURCE: National Science Foundation, Science Resources Studies Division, 1995 SESTAT (Scientists and Engineers Statistics Data System), Work History Module. *Science & Engineering Indicators – 1998*

Text table 3-4.
Comparison of degree field and occupation field for recent S&E Ph.D.s: 1995
(Percentages)

Ph.D. degree field	Occupation field: Same as degree	Other S&E	Related non-S&E	Unrelated non-S&E
All S&E	61.5	7.0	29.1	2.4
Life sciences	58.0	4.6	35.6	1.8
Math and computer sciences	65.1	3.6	26.8	4.5
Physical sciences	59.8	10.3	27.4	2.5
Social sciences	69.5	4.2	23.1	3.2
Engineering	55.9	12.0	30.6	1.5

NOTE: Recent Ph.D.s are those who received their degrees one to three years previously.

SOURCE: National Science Foundation, Science Resources Studies Division, 1995 Survey of Doctorate Recipients.

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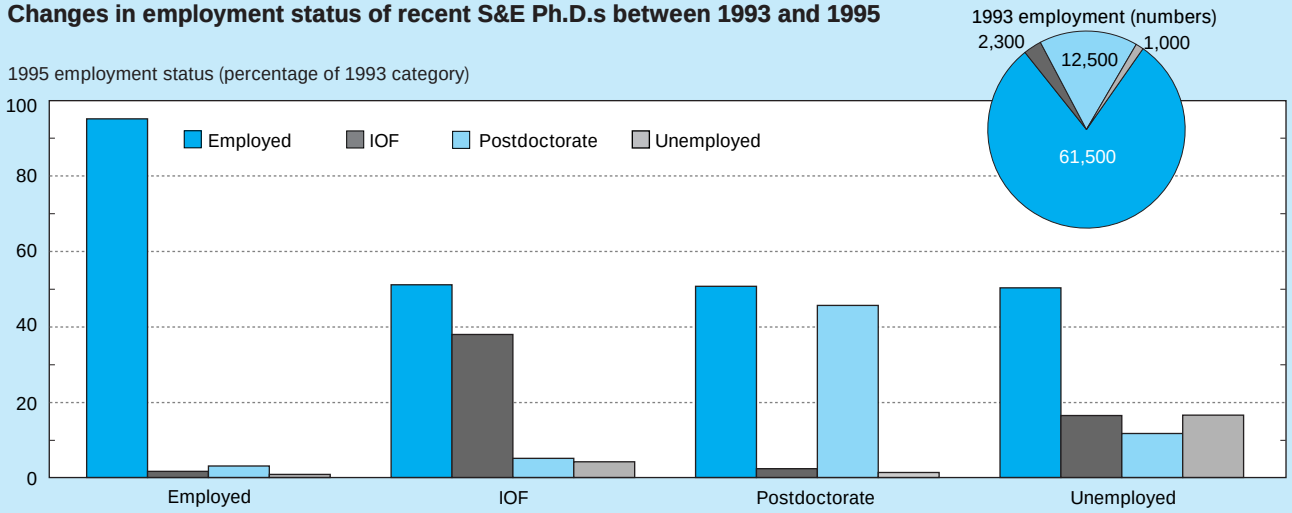
postdoctorates were still in a postdoctorate position in 1995; 37 percent of those working involuntarily outside of their fields were IOF in 1995 as well. There was, however, much less evidence of long-term unemployment: only 0.3 percent were unemployed in both 1993 and 1995.

Median Annual Salaries

The median salary earned by recent science and engineering Ph.D. recipients in 1995 was $40,000, with the highest median found for engineering Ph.D.s ($54,000) and the lowest for Ph.D.s in the life sciences ($32,000). Despite the wide variety of employment types and fields for new Ph.D. recipients, there is a fairly narrow distribution of salaries around this median—the 10th percentile makes $22,500 and the 90th percentile, $65,000. (See text table 3-5.) The lowest 10th percentile salary ($8,000) is found for recent Ph.D. recipients in sociology/anthropology. The highest 90th percentile salary was $85,000, for recent Ph.D. recipients in the computer sciences and economics.

Figure 3-1.
Changes in employment status of recent S&E Ph.D.s between 1993 and 1995



NOTES: Recent Ph.D.s are those who received their degrees between 1990 and 1992. IOF is involuntarily out of field.

SOURCE: National Science Foundation, Science Resources Studies Division, Survey of Doctorate Recipients, merged 1993 and 1995 files.

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Text table 3-5.
Salary distribution for recent S&E Ph.D.s, by degree field: 1995
(Dollars)

Ph.D. degree field	Percentile				
	10th	25th	Median	75th	90th
All S&E	22,500	30,000	40,000	54,400	65,000
Life sciences	22,000	26,000	32,000	43,500	58,000
Agricultural sciences	24,000	26,500	37,949	47,900	55,000
Biological sciences	21,000	25,000	30,000	37,000	52,000
Health/medical sciences	25,000	35,480	45,000	55,000	65,000
Math and computer sciences	28,500	35,000	45,000	60,000	75,000
Mathematics	25,000	32,000	36,000	47,000	64,000
Computer sciences	40,000	44,500	55,000	70,000	85,000
Physical sciences	22,000	30,000	38,000	52,000	61,000
Chemistry	20,000	27,000	42,000	55,000	62,000
Earth, atmospheric & oceanographic	25,000	32,000	37,000	46,000	60,000
Physics	24,000	30,000	36,000	50,000	60,000
Social sciences	19,600	30,000	38,000	49,850	67,933
Economics	36,000	42,000	48,000	60,000	85,000
Political science	25,000	32,000	37,000	50,500	71,600
Psychology	18,500	28,000	37,500	48,500	67,000
Sociology/anthropology	8,000	25,600	33,000	40,000	52,700
Engineering	32,000	43,000	54,000	63,000	72,000
Chemical	31,000	46,000	58,200	65,000	68,000
Civil	35,000	43,000	48,000	55,400	66,600
Electrical	38,000	50,000	60,000	68,000	79,600
Mechanical	36,000	45,000	52,000	60,000	67,000

NOTE: Recent Ph.D.s are those who received their degrees one to three years previously.

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Another meaningful way to view new doctorate salaries is by sector of employment. Median salaries in 1995 for recent Ph.D.s were highest in the private, noneducation sector ($56,000) and lowest for postdoctorates ($28,000). (See text table 3-6.) Government salaries tended to be just slightly above those of tenure-track positions in academia.[5] While the pattern of salary by degree field also varied by sector of employment, salaries were generally higher in engineering and math/computer sciences and lower in the social and life sciences.

Postdoctorate Appointments

A postdoctoral appointment is defined here as a temporary position awarded in academia, industry, or government primarily for the purpose of gaining additional training in research. This definition is used in the 1995 Survey of Doctorate Recipients to ask respondents about current and past postdoctorate positions they have held.[6]

Data and analyses on postdoctorates are closely related to recent Ph.D. labor market issues. In addition to gaining more training, recent Ph.D. recipients may accept a temporary, usually lower paying, postdoctorate position because a more permanent job in their field is not available. NSB (1996) reported that there was no strong evidence that the number or length of postdoctorate positions was being driven by changes in labor market conditions. With the new data provided by an extensive postdoctorate module in the 1995 Survey of Doctorate Recipients, some labor market effects can now be discerned in some specific disciplines.

Reasons for Taking a Postdoctorate. The most commonly reported reason given by 1995 postdoctorates for taking a postdoctorate appointment was to acquire additional training in their Ph.D. field (35.4 percent).[7] Other respondents reported that they were taking a postdoctorate to receive training outside of their respective Ph.D. field[8] (18.5 percent) or to work with a particular researcher or institution (21.5 percent). Text table 3-7 shows reported reasons for taking a postdoctorate in the six fields that accounted for 92 percent of 1995 S&E postdoctorate appointments.

Beyond these traditional uses of a postdoctorate, 17.1 percent of respondents reported that they accepted a postdoctorate appointment because other employment was not available. This proportion rises to 29.3 percent in the earth, atmospheric, and oceanographic sciences and to 26.8 percent in physics—two fields with relatively high unemployment and IOF rates among recent Ph.D. graduates.

Incidence and Length of Postdoctorate Appointments. Although there are some postdoctorate positions in all academic disciplines, most are concentrated in a small number of fields in which postdoctorate appointments are part of a traditional career path. Although some scientists and engineers appear to take postdoctorate positions at all points in their careers, they usually do so within a few years of completing their doctorate. (See figure 3-2.) The incidence of postdoctorate appointments is greatest in the biological sciences and physics, but few are in postdoctorate positions in these fields beyond six years after degree award.[9]

Text table 3-8 provides information from the SDR Postdoctorate Module on the proportion of each graduation cohort that ever held a postdoctorate position and the median

[5]Salaries reported on an "academic year" basis have not been adjusted upwards, as was done in pre-1996 volumes of *Science & Engineering Indicators*.

[6]It is clear, however, that the exact use of the term "postdoctorate" differs among academic disciplines, among different universities, and among the different sectors that employ postdoctorates. It is likely that these differences in labeling affected self-reporting of postdoctorate status on the Survey of Doctorate Recipients.

[7]A recent joint National Science Foundation-French National Center for Scientific Research (CNRS) project to study French doctorates and postdoctorates in the United States showed a similar pattern. Although not a fully representative sample, many of the respondents noted that the reason they took a postdoctorate in the United States was to improve their job opportunities in France (see Terouanne 1997).

[8]Many respondents to this question may have interpreted "field" very narrowly, so training outside of their field may simply refer to a subfield of their discipline that lies outside their dissertation work.

[9]The profile of those who had a postdoctorate in 1995 does not reveal much about the length of time spent in postdoctoral appointments—a person in a postdoctorate six years after obtaining a Ph.D. may have just begun the appointment. The profile also does not reveal much about how postdoctorates today differ from their historical patterns.

Text table 3-6.
Salaries of recent S&E Ph.D.s, by degree field and employment sector: 1995
(Dollars)

Ph.D. degree field	Private, noneducational	Government	Tenure track	Postdoctorate	Other education
All S&E	56,000	46,000	41,300	28,000	35,000
Life sciences	52,000	42,500	42,500	26,500	33,900
Math and computer sciences	65,000	61,250	43,000	35,000	35,900
Physical sciences	55,000	52,000	38,000	30,000	34,000
Social sciences	48,000	44,784	38,200	27,000	34,000
Engineering	60,000	52,000	49,300	33,000	43,000

SOURCE: National Science Foundation, Science Resources Studies Division, 1995 Survey of Doctorate Recipients.

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Text table 3-7.
Reasons for taking current postdoctorate, by field: 1995
(Percentages)

Ph.D. degree field	Additional training in Ph.D. field	Training outside of Ph.D. field	Work with a particular person or place	Other employment not available	Other
All S&E	35.4	18.5	21.5	17.1	7.5
Agricultural sciences	38.1	13.7	11.8	20.6	15.8
Biological sciences	38.6	23.2	20.9	11.1	6.3
Chemistry	26.3	13.0	18.4	21.8	10.4
Earth, atmospheric & oceanographic sciences	25.2	3.4	38.7	29.3	3.4
Physics	33.1	12.1	21.6	26.8	6.5
Psychology	43.0	11.5	21.7	13.1	10.8

SOURCE: National Science Foundation, Science Resources Studies Division, 1995 Survey of Doctorate Recipients, Postdoctorate Module.

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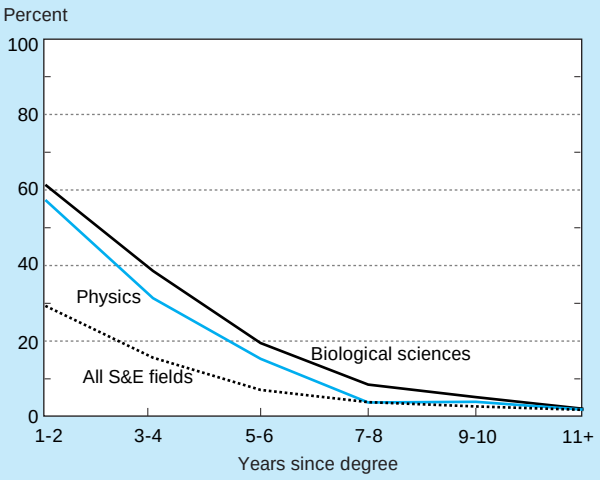
Figure 3-2.
Percentage of Ph.D.s in postdoctorate positions, by years since degree: 1995



SOURCE: National Science Foundation, Science Resources Studies Division, 1995 Survey of Doctorate Recipients.

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Text table 3-8.
Incidence and length of postdoctorate appointments, by selected S&E fields: 1995

Field	Years since Ph.D. degree 1-3	4-6	7-10	11-20	21-30	31+
Percentage ever in postdoctorate appointment						
All S&E	41.3	37.9	36.3	34.0	29.2	25.0
Agricultural sciences	43.9	43.9	35.0	27.6	19.2	14.0
Biological sciences	71.0	71.5	71.8	66.3	51.2	39.9
Chemistry	63.0	57.7	55.2	46.1	50.6	30.5
Earth, atm. & ocean. sciences	48.5	52.3	40.0	37.3	21.4	15.3
Physics	72.9	68.1	59.0	52.7	44.4	29.3
Psychology	31.8	23.6	27.3	25.3	21.3	22.5
Months spent in postdoctorate appointment						
All S&E	18	29	29	26	23	20
Agricultural sciences	20	20	22	25	25	12
Biological sciences	23	46	45	38	28	24
Chemistry	19	22	24	22	23	16
Earth, atm. & ocean. sciences	17	23	19	16	12	14
Physics	23	34	32	25	24	23
Psychology	12	15	16	20	13	19

NOTES: Fields selected are those with a high incidence of postdoctorate appointments. "Months spent in postdoctorate appointment" refers to the median of the sum of the lengths of each reported postdoctorate experience.

SOURCE: National Science Foundation, Science Resources Studies Division, 1995 Survey of Doctorate Recipients, Postdoctorate Module.

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number of months in postdoctorates for those who held them.[10] For the more recent cohorts, particularly those only one to three years since degree, length of time in postdoctorate is constrained by the limited time they have held their degrees.

Across all fields, the Postdoctorate Module shows a steady increase over time in both the incidence and length of postdoctorate experiences. It is difficult to tie these trends directly to labor market events or even to claim a consistent pattern across fields. In physics, chemistry, and psychology—fields with distinct labor markets—the incidence of postdoctorates between one to three and four to six years after degree has risen, despite the lesser opportunity of the younger cohort to obtain a postdoctorate. In psychology, the agricultural sciences, and chemistry, there is no trend toward longer

[10]Recall bias may well lead to underreporting of postdoctorate experiences by older cohorts, but this occurrence may be less problematic than comparisons of reported postdoctorate rates among the sometimes dissimilar survey instruments used over the years. For length of appointment, up to three postdoctorates reported in the Postdoctorate Module are aggregated.

postdoctorate appointments. In the biological sciences, even the mid-career cohort—11 to 20 years after degree—had a very high incidence (66.3 percent) and length (38 months) of postdoctorate positions.

Postdoctorate Transitions: What Were 1993 Postdoctorates Doing in 1995? Of those in postdoctorate positions in April 1993, 41.6 percent were still in a postdoctorate position in April 1995. (See text table 3-9.) Only 12.1 percent transitioned from a postdoctorate to a tenure-track position at a four-year educational institution; 21.2 percent found other positions at educational institutions, and 16.6 percent went to work for a private for-profit firm.

The percentage of postdoctorates obtaining tenure-track positions is not large even for those with greater time since degree—only 18.8 percent of 1993 postdoctorates who were five to six years since degree were in tenure-track positions in 1995. (See text table 3-10.) This is, however, a much greater rate of transition to permanent academic jobs than for postdoctorates one to two years since degree (10.4 percent). One in five is still a low rate if an academic career is viewed as the primary objective of most Ph.D. scientists accepting a postdoctorate appointment at that point in their career.

For those in postdoctorates seven or more years after their degree, the rate of transition to tenure-track appointments drops to 9.8 percent. To a great extent, this rate is driven by career patterns in the biological sciences, where there have long been large numbers of Ph.D. scientists pursuing multiple postdoctorate appointments. However, in physics—where multiple postdoctorates are a more recent phenomenon[11]—the percentage of postdoctorates transitioning to tenure-track appointments begins to drop much earlier (three to four years since degree), to 7.1 percent.

For both physics and the biological sciences, the unemployment rate in 1995 for 1993 postdoctorates was greatest for those with more time since degree—3.4 percent for biological scientists seven or more years since degree and for physicists three to four years after degree. There was also an increase in the rate of transition to the "other education" category. This category includes some individuals who become adjunct faculty, but it primarily encompasses other non-tenure-track research and administrative jobs at a university.

[11]See text table 3-8 for the historical pattern of postdoctorates. Due to the small numbers of physicists in postdoctorates beyond four years after their degree, there was not a sufficient sample size to estimate transition rates.

Selected Characteristics of the S&E Workforce

The data in this section are drawn from the National Science Foundation's (NSF's) Scientists and Engineers Statistical Data System (SESTAT),[12] which is a unified database containing information on the employment, education, and other characteristics of the nation's scientists and engineers. For a discussion of labor force indicators drawn from other surveys, see "The S&E Labor Market Since 1995: Indicators From Other Surveys."

Basic Characteristics

Of the approximately 3.3 million individuals in science and engineering occupations in the labor force in 1995, only 2.2 percent (70,600) reported themselves as unemployed. The highest unemployment rate was reported for physical

[12]SESTAT data are collected from three component surveys sponsored by NSF and conducted periodically throughout each decade: (1) the National Survey of College Graduates, (2) the National Survey of Recent College Graduates, and (3) the Survey of Doctorate Recipients. SESTAT's target population is residents of the United States with a bachelor's degree or higher (in either an S&E or non-S&E field) who, as of the study's reference period, were:

- non-institutionalized,
- not older than age 75, and
- either trained or working as a scientist or engineer—i.e., either had at least one bachelor's or higher degree in an S&E field or had a bachelor's or higher degree in a non-S&E field and worked in an S&E occupation as of the reference week.

For the 1995 SESTAT, the reference period was the week of April 15, 1995.

Text table 3-9.
Employment status of 1993 postdoctorates, by S&E field: 1995
(Percentages)

Field	Post-doctorate	Tenure track at 4-year institution	Other education	Private for-profit	Private not-for-profit/ government	Unemployed
All S&E	41.6	12.1	21.1	16.6	6.9	1.6
Agricultural sciences	47.5	5.8	18.9	15.8	6.7	5.4
Biological sciences	47.8	12.0	20.5	12.9	4.9	1.9
Chemistry	35.2	13.2	12.5	32.0	6.4	0.9
Earth, atmospheric & oceanographic sciences	34.0	12.6	33.2	7.8	12.5	0.0
Physics	43.0	12.7	20.9	14.7	6.2	2.6
Psychology	34.4	11.3	28.2	15.1	11.0	0.0

SOURCE: National Science Foundation, Science Resources Studies Division, Survey of Doctorate Recipients, merged 1993 and 1995 files.

Science & Engineering Indicators – 1998

Text table 3-10.
Postdoctorate transitions by years since 1993 degree: 1995
(Percentages)

Postdoctorate field and years since 1993 degree	1995 employment status of 1993 postdoctorates					
	Tenure track	Post-doctorate	Other education	Non-education	IOF	Unemployed
All S&E	11.9	40.5	20.2	21.4	3.1	1.6
1-2 years	10.4	45.8	16.2	22.2	3.3	1.0
3-4 years	13.4	36.5	21.9	21.3	2.3	2.7
5-6 years	18.4	35.8	18.6	18.7	3.7	2.5
7 or more years	9.8	28.4	33.1	20.2	3.9	1.7
Biological sciences	11.6	46.5	19.2	15.8	2.8	1.9
1-2 years	6.3	58.8	15.6	14.1	3.1	0.7
3-4 years	16.5	38.0	19.5	19.1	1.6	2.9
5-6 years	20.1	35.6	18.2	16.2	3.7	2.5
7 or more years	13.4	27.9	34.2	14.2	4.1	3.4
Physics	12.5	42.3	20.6	17.6	3.3	2.6
1-2 years	14.0	47.5	13.5	16.8	5.9	1.9
3-4 years	7.1	35.8	35.2	15.5	0.0	3.4
5-6 years	n/s	n/s	n/s	n/s	n/s	n/s
7 or more years	n/s	n/s	n/s	n/s	n/s	n/s

n/s = not surveyed

SOURCE: National Science Foundation, Science Resources Studies Division, Survey of Doctorate Recipients, merged 1993 and 1995 files.

NOTE: Some percentages may differ from those in text table 3-9 due to the inclusion of involuntarily out-of-field (IOF) employment.

Science & Engineering Indicators—1998

The S&E Labor Market Since 1995: Indicators From Other Surveys

Although detailed biennial surveys of individuals such as NSF's SESTAT allow examination of complex patterns and long-term trends in education and employment, they are less well-suited to tracking short-term changes in employment rates. Data from the 1997 NSF labor force surveys are still in the process of being collected, but other data may serve as indicators of changes in market conditions since April 1995. In general, these data suggest that labor market conditions are improving. This is consistent with improvements in the general economy, specifically with unemployment rates for all workers, as measured by the monthly Current Population Survey, which dropped from 5.7 percent in April 1995 to 4.7 percent in October 1997. Thus:

- The American Mathematical Society surveyed 1996-97 new recipients of mathematics Ph.D.s in the fall of 1997. This soon after graduation, the unemployment rate was a relatively high 6.8 percent. However, this rate represents a large decrease from the 14.7 percent unemployment rate found for the 1994-95 Ph.D. cohort two years earlier by the same survey.
- The American Institute of Physics estimated a 4.0 percent unemployment rate for the 1994-95 cohort of recipients of physics Ph.D.s in the winter after their degrees. The corresponding estimate of the previous year, for the 1993-94 cohort, was 5.0 percent unemployment.
- In 1997, several S&E professional societies, in collaboration with the Commission on Professionals in Science and Technology, coordinated their surveys of new Ph.D.s. Among other common survey items, recent Ph.D. recipients were asked to characterize on a scale of 1 to 5 (where 1 is strongly disagree and 5 is strongly agree) their agreement with various statements about their current jobs. Preliminary results are available for chemistry, chemical engineering, computer sciences, earth and space sciences, and psychology. New Ph.D.s in these fields showed much agreement that their current jobs were "at least somewhat related to my field" (average values within a field ranged from 4.3 for chemical engineering to 4.6 for the computer sciences); and that the job was "commensurate with my education and training" (mean scores of 4.1 to 4.4). However, there was less agreement with "position similar to what I expected to be doing when I began my doctoral program," with mean values ranging from 3.4 in psychology to 3.7 in the computer sciences.

scientists (2.7 percent) and the lowest for social scientists (1.2 percent). By degree level, only 2.1 percent of the scientists and engineers whose highest degree was a bachelor's degree and 1.8 percent of those with a doctorate were unemployed, compared to 2.5 percent of those with a master's degree. (See figure 3-3.)

Employment by Field

Engineers represented 42 percent (1.34 million) of the employed scientists and engineers in 1995; followed by computer and math scientists, who accounted for 30 percent (950,000) of the total. (See appendix table 3-4.) Physical scientists accounted for less than 10 percent of the S&E workforce in 1995. By subfield, electrical engineers made up about one-fourth (357,000) of all employed engineers, while biological scientists accounted for a little over half (169,000) of the employment in the life sciences. In physical and social science occupations, chemists (111,000) and psychologists (167,000) made up the largest occupational subfields, respectively.

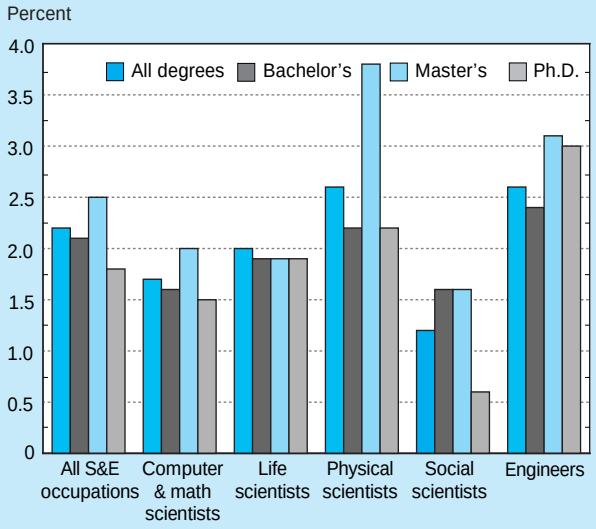
Highest Degree Level

Almost 58 percent of those working in S&E occupations in 1995 reported their highest degree as a baccalaureate, while 28 percent listed a master's degree and 13 percent a doctorate. (See appendix table 3-4.) Other professional degrees were reported as the highest degree type achieved by about 1 percent of the S&E workforce. Almost half of those with bachelor's degrees were employed as engineers. (See text table 3-11.) Another 34 percent had jobs as computer and math scientists. These occupations were also the most popular among those with master's degrees (40 percent and 30 percent, respectively). Most doctorate-holders were employed in the social sciences (27 percent), life sciences (25 percent), and physical sciences (19 percent).

Relationship Between Occupation and Education

Approximately 83 percent (2.6 million) of those in the S&E workforce in 1995 had their highest degree in an S&E field; the exact proportions vary by highest degree level.

Figure 3-3.
Unemployment rates of scientists and engineers, by broad occupation and highest degree received: 1995



NOTE: Total includes other professional degree recipients.

See appendix table 3-3. *Science & Engineering Indicators –1998*

About 74 percent of master's degrees were in an S&E field, compared to 94 percent of doctoral degrees (NSF 1995c). By field, almost 77 percent of engineers and 80 percent of social scientists were working in their highest degree fields. Similar proportions existed among physical scientists (73 percent) and life scientists (71 percent). By contrast, over 57 percent of computer and math scientists reported their highest degrees to be in other fields. (See text table 3-12.)

A large number of people trained in S&E disciplines routinely find S&E-related employment in nontraditional S&E occupations. For example, approximately 4.7 million people with S&E degrees were employed in non-S&E occupations in 1995; about 65 percent of these reported that their work was at least somewhat related to their degrees. (See text table 3-13.) Approximately four-fifths of both doctoral and master's S&E de-

Text table 3-11.
Distribution of employed scientists and engineers, by broad occupation and highest degree received: 1995
(Percentages)

Occupation	Total	Bachelor's degree	Master's degree	Ph.D. degree	Other professional degree
All scientists and engineers	100.0	100.0	100.0	100.0	100.0
Computer and math scientists	29.8	33.9	30.0	12.9	8.8
Life scientists	9.6	6.6	7.2	24.5	56.7
Physical scientists	8.6	6.9	7.5	18.9	0.6
Social scientists	10.0	3.3	15.2	27.1	25.8
Engineers	42.0	49.3	40.1	16.7	8.1

See appendix table 3-4. *Science & Engineering Indicators – 1998*

Text table 3-12.
Distribution of employed scientists and engineers, by broad occupation and degree field: 1995
(Percentages)

Occupation	Total	Degree field (all levels)					
		Math & computer sciences	Life sciences	Physical sciences	Social sciences	Engineering	Non-S&E
All scientists and engineers	100.0	14.0	9.3	9.8	12.1	37.5	17.3
Computer and math scientists	100.0	42.8	2.3	3.9	9.3	15.3	26.3
Life scientists	100.0	0.5	71.1	6.4	4.7	1.2	16.1
Physical scientists	100.0	1.8	12.2	73.2	2.7	5.2	5.0
Social scientists	100.0	0.5	1.1	0.3	79.7	0.5	17.8
Engineers	100.0	2.4	1.6	4.1	1.6	76.8	13.6

See appendix table 3-5.

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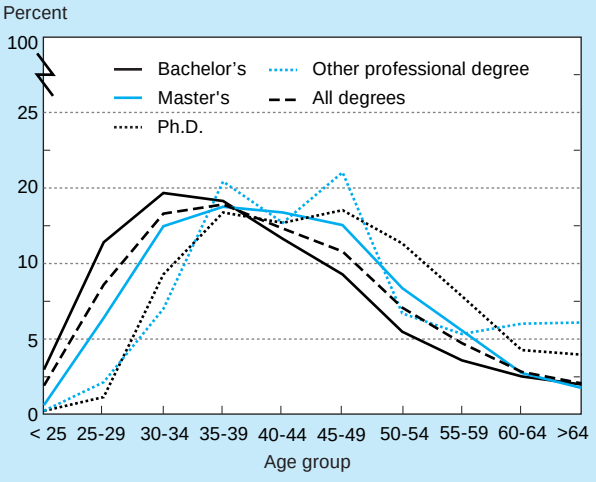
gree recipients who were employed in non-S&E occupations in 1995 reported that their jobs were closely related to their degrees, compared to three-fifths of bachelor's degree-holders.

Age Distribution

Age distributions for S&E occupations are affected by historical S&E degree production patterns, net immigration, occupational mobility, morbidity, and mortality. For each degree level and field, the greatest population density occurs during prime productive years—i.e., during the late 30s and throughout the 40s. (See figure 3-4.) This trend reflects the pattern of S&E degree production over the last 50 years—rapid growth with a more recent slowing. Scientists or engineers nearing traditional retirement and high mortality ages are far less numerous than those in the early stages of their careers. This age distribution has several implications for the S&E labor force:

Figure 3-4.
Age distribution of employed scientists and engineers, by highest degree received: 1995



See appendix table 3-6.

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- Barring very large reductions in degree production or increases in retirement rates, the number of trained scientists and engineers in the workforce will continue to increase for some time. The number of individuals who are now receiving S&E degrees greatly exceeds the number of S&E-trained workers who are near traditional retirement ages.
- The number of scientists and engineers reaching traditional retirement ages will increase dramatically over the next 25 years at every degree level.
- If there is less rapid growth in degree production than in the past, the average age of trained scientists and engineers in the labor force will increase. There are many advantages to having a more experienced S&E labor force. However, in many Ph.D. fields, the greatest productivity in terms of articles published often occurs early in an individual's career.

Sector of Employment

The private for-profit sector is by far the largest employer of S&E workers. In 1995, 72 percent of scientists and engineers with bachelor's degrees and 59 percent of those with master's degrees were employed in a private for-profit company. Academia was the largest sector of employment for those with doctorates (43 percent). Sectors employing smaller numbers of S&E workers include educational institutions other than four-year colleges and universities, nonprofit organizations, and state and local government agencies.

Among S&E occupations, there is a wide variation in the proportions of scientists and engineers employed in private for-profit industry. While nearly three-fourths of both computer and math scientists and engineers were employed in this sector, only one-fourth of life scientists and one-fifth of social scientists were so employed in 1995. (See appendix table 3-7.) Educational institutions employed the largest proportions of life scientists (49 percent) and social scientists (44 percent).

Text table 3-13.
S&E degree-holders employed in non-S&E occupations, by relationship of degree to job and highest degree received: 1995
(Percentages)

S&E degree obtained	Total number in non-S&E occupations	Relationshop of degree to job		
		Closely related	Somewhat related	Not related
All degree-holders	4,690,200	32.6	32.4	35.0
Bachelor's	3,821,100	29.0	32.9	38.1
Master's	699,200	48.3	29.8	21.9
Ph.D.	166,500	48.2	34.1	17.6
Other professional	3,400	71.5	0.0	28.5

SOURCE: National Science Foundation, Science Resources Studies Division, 1995 SESTAT (Scientists and Engineers Statistics Data System) Surveys of Science and Engineering College Graduates, unpublished tabulations.

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Salaries

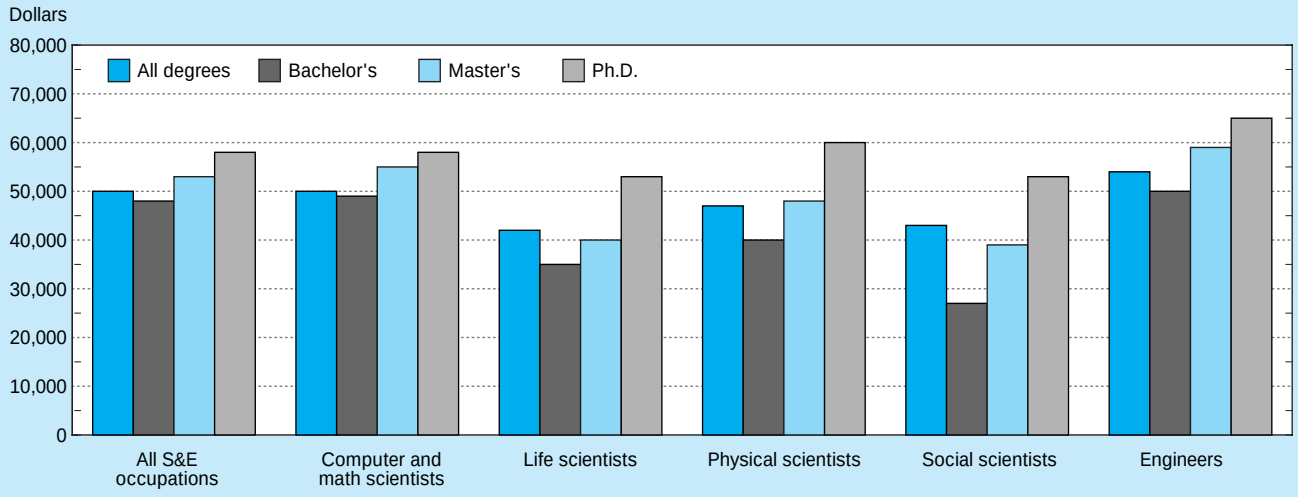
Median annual salaries of all S&E workers serve as an excellent indicator of the relative demand for workers in various S&E fields. In 1995, the median annual salary of employed bachelor's degree-holders was $48,000; for master's recipients, it was $53,000; and for doctorate-holders, $58,000. (See figure 3-5.) Engineers commanded the highest salaries at each degree level. The second highest salaries were earned by computer and math scientists at both the bachelor's and master's levels, and physical scientists at the doctorate level. The lowest median salaries were reported for social scientists at each degree level.

Median salaries for scientists and engineers rise steadily with the number of years since degree completion. For example, individuals who earned their bachelor's or master's degrees in the early 1990s earned about $15,000 less in 1995 than those who received their degrees in the early 1980s (NSF 1995c). For doctorate-holders, the difference is $18,000. (See text table 3-5 for salary comparisons of those with recent Ph.D.s.)

Women in the S&E Workforce

The U.S. workforce has experienced dramatic changes in its composition during the last half of the 20th century. These changes are attributable in large part to demographic changes stemming from immigration and from birth rates that differ

Figure 3-5.
Median annual salaries of employed scientists and engineers, by broad occupation and highest degree received: 1995



NOTE: Total includes other professional degree recipients.

See appendix table 3-8.

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among racial and ethnic subgroups in the United States. The majority of net new entrants to the workforce are women and minorities. These general trends are also reflected in the S&E workforce.

Employment by Field

Women comprised a little over 22 percent of the S&E workforce in 1995. (See figure 3-6.) Women are best represented in the social sciences, where they account for one-half of all workers; they are least represented in the physical sciences (22 percent) and engineering (9 percent). Among the science subfields, women are well-represented in biological sciences (40 percent) and in mathematics (33 percent). Within engineering subfields, women are best represented in chemical and industrial engineering (13 percent each) and least represented in aerospace and mechanical engineering (6 percent each).

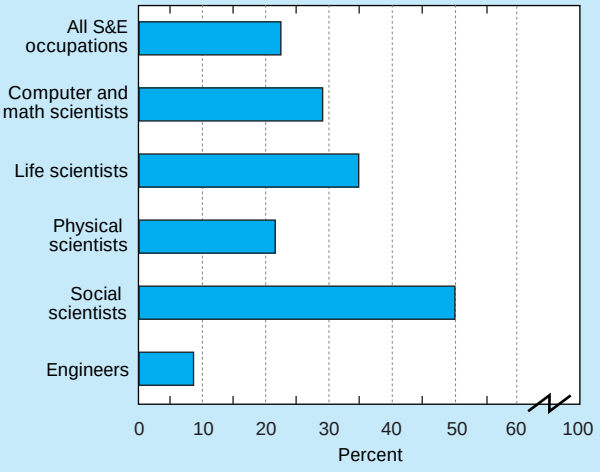
Highest Degree Level

By level of degree, 13 percent of women in S&E occupations report a doctorate as their highest degree—the same proportion as for men. (See appendix table 3-11.) Almost one-third of women report a master's as their highest degree, compared to 27 percent of men. The proportion of women in the S&E workforce is much greater for more recent graduation cohorts at all degree levels. With the exception of computer and math scientists, well over half of the women in each broad S&E occupation at every degree level received their degrees after 1984 (NSF 1995c).

Sector of Employment

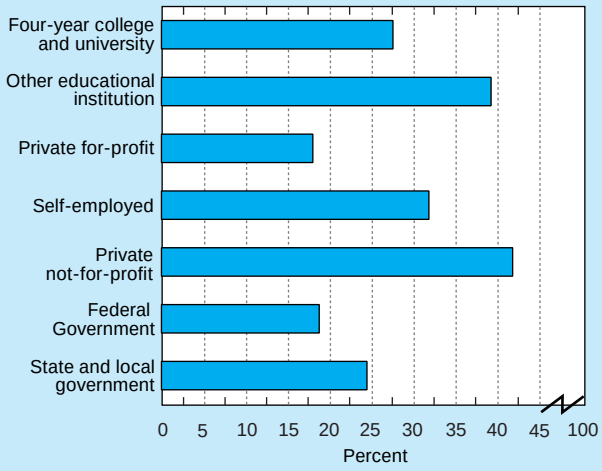
Women accounted for 28 percent of the scientists and engineers employed in four-year colleges and universities in 1995 and 39 percent of the S&E workers in other educational institutions. (See figure 3-7.) Only 18 percent of the scientists and engineers in private industry were female. However, this sectoral breakout was due to the extensive presence of women in social science occupations—a large proportion of which are jobs in educational institutio ns. Among the other employment sectors, women represented 42 percent of the S&E workers in private nonprofit organizations and 32 percent of self-employed scientists and engineers.

Figure 3-6.
Proportion of women in the S&E workforce, by broad occupation: 1995



See appendix table 3-10. *Science & Engineering Indicators – 1998*

Figure 3-7.
Women as a proportion of employed scientists and engineers, by sector of employment: 1995



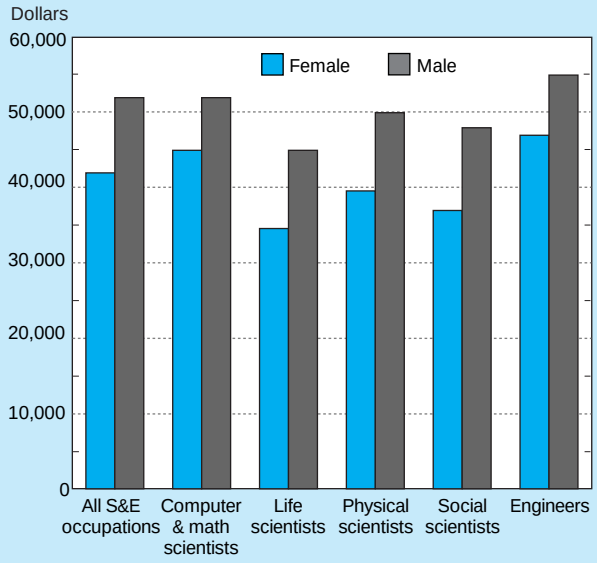
See appendix table 3-12. *Science & Engineering Indicators – 1998*

Sex and Salary

In 1995, the median annual salary for women scientists and engineers was $42,000—about 20 percent less than the $52,000 median annual salary for men. (See figure 3-8.) This difference could be influenced by several factors. For example, women were more likely than men to be working in educational institutions, in social science occupations, and in nonmanagerial positions; they also tended to have less experience than men. Among scientists and engineers in the workforce who have held their degrees five years or less, the median annual salary of S&E women was 85 percent that of men (NSF 1995c).

The salary differential varied greatly by field. In mathematics and computer sciences and in engineering occupations in 1995, women's salaries were approximately 14 percent less than men's. There was a 23 percent salary difference in social and life science occupations. Women also reported the highest and lowest median salaries in these occupations: women earned the highest median salary in engineering ($47,000) and the lowest in the life sciences ($34,600). (See appendix table 3-13.)

Figure 3-8.
Median annual salaries of employed scientists and engineers, by broad occupation and sex: 1995



See appendix table 3-13. *Science & Engineering Indicators – 1998*

Racial/Ethnic Minorities in the S&E Workforce

Minorities, except for Asians, are a small proportion of employed scientists and engineers in the United States. Asians, who make up 4 percent of the U.S. population (U.S. Bureau of the Census 1997), accounted for 10 percent of all S&E workers in 1995. Blacks and Hispanics made up 3.4 and 2.8 percent of the S&E workforce, respectively, in 1995; yet they represented 12 and 9 percent of the U.S. population. (See text table 3-14.)

Text table 3-14.
Distribution of employed scientists and engineers, by broad occupation and race/ethnicity: 1995
(Percentages)

Occupation	White	Black	Hispanic	Asian/ Pacific Islander	Native American
All scientists & engineers	83.9	3.4	2.8	9.6	0.3
Computer & math scientists	82.7	4.1	2.4	10.6	0.2
Life scientists	84.2	3.2	2.8	9.5	0.2
Physical scientists	84.8	2.8	2.5	9.6	0.3
Social scientists	87.5	5.2	3.1	3.7	0.5
Engineers	83.7	2.6	3.1	10.3	0.3

See appendix table 3-10. *Science & Engineering Indicators – 1998*

Employment by Field

Among broad S&E occupations, Asians—84 percent of whom are foreign-born (NSF 1995c)—are the best represented minority group in computer or math sciences, physical sciences, life sciences, and engineering. In each of these occupations, Asians account for around 10 percent.

The underrepresented minorities—blacks, Hispanics, and Native Americans—are more likely to enter the social sciences and least likely to enter the physical sciences. Blacks are the best represented minority group in social science occupations (5 percent). Blacks also account for 4 percent of computer and math scientists. (See appendix table 3-10.)

Highest Degree Level

Proportionately, Asians tend to have higher levels of education than whites or underrepresented minorities. Almost 60 percent of Asians in the S&E workforce have a master's or doctorate degree as their highest degree, compared to about 40 percent for whites and 35 percent for other minority groups. (See appendix table 3-11.)

Sector of Employment

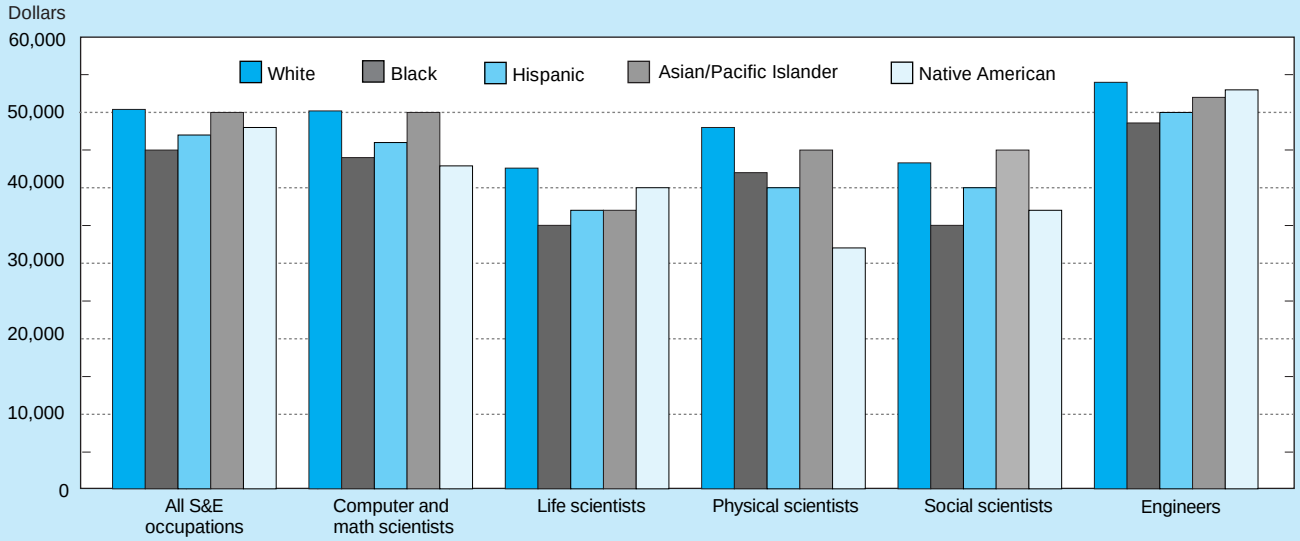
Representation of minority groups differs by employment sector. Asians are the best represented minority group in four-year colleges and universities (13 percent), in industry (10 percent), and in the other employment sectors. Blacks are the second best represented minority in the Federal Government (5.4 percent) and in state and local government (5.1 percent). (See appendix table 3-12.)

Salaries

Median annual salaries of Asian scientists and engineers in 1995 did not vary significantly from those of whites ($50,000 versus $50,400, respectively). In contrast, the salaries of other minority groups were generally 5 to 10 percent below that of whites. (See figure 3-9.) As with women, the salary difference was mostly due to the greater proportion of minorities in the lower paying social science occupations and to their having fewer years of work experience than whites. However, the salary gap almost disappears with more recent entrants into the S&E workforce (that is, those who received their degree five years ago or less), as the median annual salaries are about the same for all racial/ethnic groups (NSF 1995c).

In 1995, the highest median annual salaries for all racial/ethnic groups were in engineering occupations. Black engineers earned $48,600; Hispanic engineers, $50,000; Asian engineers, $52,000; and Native American engineers, $53,000. The lowest salaries for blacks were in social and life science occupations ($35,000); for Native Americans, physical science occupations were the lowest paying ($32,000); and for Hispanics, it was life science occupations ($37,000). (See appendix table 3-13.)

Figure 3-9.
Median annual salaries of employed scientists and engineers, by broad occupation and race/ethnicity: 1995



See appendix table 3-13.

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S&E Job Patterns in the Service Sector[13]

Although the service sector accounted for only 4 percent of the scientists, 10 percent of the engineers, and 26 percent of the technicians employed in the United States in 1994 (the latest year for which data are available), analysts look to service sector employment as a leading indicator of the health of the S&E labor market, given the economic shift from a manufacturing to a service-oriented base.[14] The term "service sector" as used here denotes establishments engaged in wholesale and retail trade, transportation, communication, and utilities. Employment of scientists, engineers, and technicians in the service sector increased from 1988 to 1991, then dropped sharply from 1991 to 1994. By 1994, the number of employed scientists and engineers in service industries (185,200) was 8 percent below the 1988 level of 202,000 and 15 percent below the 1991 level of 219,000.[15] (See text table 3-15.)

Engineering and technician employment was particularly affected by the downturn, as the 1994 total of 129,800 engineers employed in the service sector represented a drop of 11 percent from 1988 and 16 percent from 1991. Technician employment dropped 12 percent over the six-year period. Although employment of scientists dropped 13 percent between 1991 and 1994, the overall decline for the 1988-94 period was negligible.

Principal Employers

As described here, the service sector is divided into three major industry groups: (1) transportation, communications, and utilities; (2) wholesale trade; and (3) retail trade. Within these groups, three industries accounted for 80 percent of total employed scientists and engineers in the service sector in 1994, down from 85 percent in 1988:

- wholesale trade—durable goods, 31 percent of service sector S&E employment in 1994;
- utilities (electric, gas, and sanitary services), 29 percent; and
- communications, 20 percent.

Most of the total sectoral drop in S&E employment between 1988 and 1994 occurred in wholesale trade—durable goods, where 13,500 S&E jobs (19 percent of the industry's 1988 S&E workforce) were lost; and in communications, where 9,000 S&E jobs (20 percent of the industry's 1988 S&E workforce) were lost. (See figure 3-10.)

Partially offsetting the sizable loss in these two industries were gains in wholesale trade—nondurable goods, which provided 2,900 jobs, representing 35 percent of the industry's 1988 S&E workforce; and retail trade, with

[13]Information in this section is from NSF (1997d).

[14]Service sector industries are those included in Standard Industrial Classification codes 40-59. Excluded are educational services and state and local governments. Other industries traditionally thought of as "service" industries—such as financial, insurance, real estate, and legal service; entertainment; health services; social services; and hotels and other lodging places—are covered under a separate survey cycle on nonmanufacturing industries; these were last reported on by NSF (forthcoming). Note that the industry groups referred to here as the "service sector" were denoted as "trade and regulated industries" in previous survey cycles.

[15]These data are compiled from the Occupational Employment Statistics survey conducted by the U.S. Bureau of Labor Statistics, with support from NSF. (See NSF 1997c.) Until 1996, U.S. business establishments were surveyed once every three years, with roughly one-third of the establishments covered each year. Starting with the 1996 survey cycle (for which data are not yet available), all establishments employing nonfarm wage and salary workers are being surveyed annually.

Text table 3-15.
Scientists, engineers, and technicians employed in service sector

Occupation	1988	1991	1994
All scientists, engineers, technicians	472,500	477,900	422,700
All scientists & engineers	202,000	219,000	185,200
Scientists	55,500	63,900	55,400
Engineers	146,500	155,100	129,800
Technicians	270,500	258,900	237,500

SOURCE: National Science Foundation, Science Resources Studies Division, "Services Sector S&E Employment Rises, Then Falls Sharply as Engineering and Technician Jobs Are Cut," Data Brief, NSF 97-322 (Arlington, VA: 1997).

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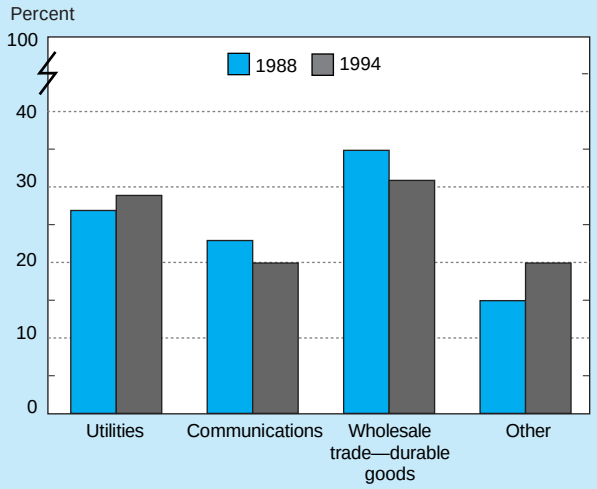
Figure 3-10.
Distribution of service sector S&E jobs, by major industry group



SOURCE: National Science Foundation, Science Resources Studies Division, "Services Sector S&E Employment Rises, Then Falls Sharply as Engineering and Technician Jobs Are Cut," Data Brief, NSF 97-322 (Arlington, VA: 1997).

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3,300 new jobs, representing 34 percent of the industry's 1988 S&E workforce, over the six-year period. In 1994, however, combined total S&E employment in these latter two industries constituted only 13 percent of sectoral S&E employment (3 percent in wholesale trade—nondurable goods and 10 percent in retail trade), which was down from 1991 levels in both industries.

Employment of Scientists

At first glance, scientists might appear to have escaped the decline experienced by their engineer and technician counterparts, as total 1994 employment of 55,400 scientists in the service sector was virtually unchanged from the 1988 figure of 55,500. However, employment of scientists had jumped to 63,900 (an increase of 15 percent) between 1988 and 1991 before falling back in 1994 to the earlier level.

Among service industries employing at least 1,000 scientists in 1991, science employment in all but one declined—often dramatically—between 1991 and 1994. These industries included general merchandise stores and air transportation (both down by 34 percent); trucking and warehousing (down 29 percent); transportation services (down 25 percent); wholesale trade—durable goods (down 20 percent); furniture and home furnishings stores (down 18 percent); wholesale trade—nondurable goods (down 13 percent); miscellaneous retail (down 5 percent); and electric, gas, and sanitary services (down 4 percent). Only in communications was there a 1991-94 increase in employment of scientists (3 percent) (NSF forthcoming).

Employment of Engineers

Of the 19 service sector industries, three accounted for 87 percent of all employed engineers in 1994:

- ♦ wholesale trade—durable goods, 45,700 (35 percent);
- ♦ electric, gas, and sanitary services, 39,900 (31 percent); and
- ♦ communications, 27,000 (21 percent).

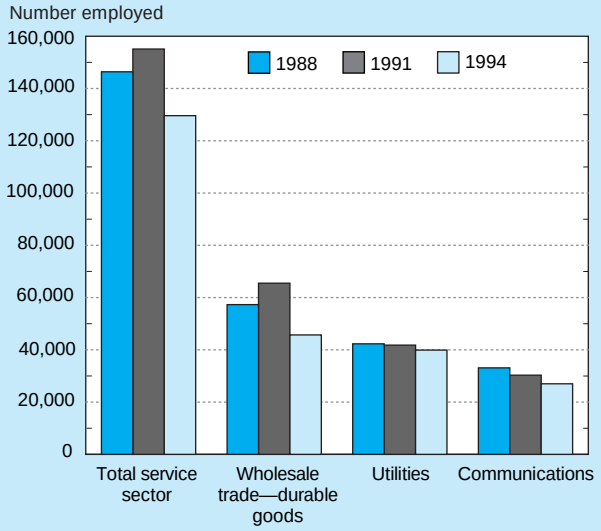
All three industries suffered declines in engineering employment over the full six-year period 1988-94 and over the shorter 1991-94 period. Wholesale trade—durable goods lost 19,800 engineering jobs between 1991 and 1994 (35 percent of the industry's 1988 engineering workforce and 30 percent of its 1991 engineering workforce). Engineering job losses were more moderate in the other two large service industries. Electric, gas, and sanitary services lost 2,400 (6 percent) of its 42,300 1988 engineering jobs; and communications lost 6,100 (18 percent) of its 33,100 1988 engineering positions. (See figure 3-11.)

Among smaller service industries employing at least 1,000 engineers in 1991, a substantial 1988-94 decline in engineering employment was suffered only by air transportation (a 4 percent decline, but dropping to 33 percent of its 1991 level). All other such service industries either maintained or increased their employment of engineers. Industries employing at least 1,000 engineers and experiencing 1988-94 increases included miscellaneous retail (67 percent), water transportation (60 percent), furniture and home furnishings stores (40 percent), and wholesale trade—nondurable goods (23 percent).

Employment of Technicians

Service sector employment of technicians was dominated by the same three industries as engineering in 1994—and, with 85 percent of this group, almost to the same extent. Wholesale trade—durable goods employed 92,300 (39 percent) of the sector's technicians and experienced the most significant declines—a loss of 10,800 jobs (4 percent) between 1988 and 1991, and an additional 13,400 jobs (13 percent) between 1991 and 1994. The combined loss of 24,200 technician jobs in wholesale trade—durable goods from 1988 to 1994 represented 73 percent of the lost technician jobs in the entire service sector over a six-year period.

Figure 3-11.
Engineering employment in the service sector, by major industry group



SOURCE: U.S. Bureau of Labor Statistics, Occupational Employment Statistics Survey.

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Communications, the second largest technician-employing service sector (64,300 jobs, or 27 percent of the sectoral total in 1994) lost 5,200 jobs between 1988 and 1991, but gained 3,000 of these back between 1991 and 1994. Electric, gas, and sanitary services—the third largest employer of technicians in the service sector—lost 5,200 (8 percent) of its 66,500 1988 technician jobs. Like communications, it gained 3,000 of these positions back between 1991 and 1994.

Scientists and Engineers in an International Context: Migration and R&D Employment

Foreign-Born Scientists and Engineers in the United States

In April 1993, 23.0 percent of individuals holding science and engineering doctorates in the United States were foreign-born.[16] (See text table 3-16.) Of these, 34.1 percent received their S&E doctorates from a foreign school. At the bachelor's degree level, 9.8 percent of those with S&E degrees were foreign-born, with 49.1 percent of degrees from foreign schools.

The relative proportions of foreign-born doctorate-holders resident in the United States vary by S&E field. Psychology had the lowest percentage of foreign-born doctorate-holders in 1993 (9.0 percent), and civil engineering had the highest (50.6 percent). In general, the percentage of immigrants was highest in fields with favorable labor market conditions (as measured by unemployment and IOF rates), such as engineering and the computer sciences. It was lowest in the social sciences (except for economics); the life sciences; and the earth, atmospheric, and oceanographic sciences.

In recent years, the number of perm anent visas issued by the U.S. Immigration and Naturalization Service (INS) to immigrants in S&E occupations has been greatly affected by immigration legislation and administrative changes at INS. The 1990 Immigration Act led to increases in the number of employment-based visas available starting in 1992.[17] (See figure 3-12.) Further, the 1992 Chinese Student Protection Act made it possible for Chinese nationals in the United States on student or other temporary

[16]These estimates are taken from the 1993 National Survey of College Graduates, which, because it samples from decennial census records—rather than, like most surveys of scientists and engineers, from lists of graduates of U.S. schools—will be the best source of data for determining the percentage of scientists and engineers that are foreign born until about 2004.

[17]Because many immigrants—including scientists and engineers—enter the United States on family-based visas, where reporting of occupation is optional, S&E occupations might be undercounted.

Text table 3-16.
Share of S&E degrees held by foreign-born recipients, by highest degree received: 1993
(Percentages)

Degree field	Bachelor's degree	Master's/other professional degree	Ph.D. degree
All S&E	9.8	18.0	23.0
Life sciences	8.0	15.0	21.3
Agricultural sciences	5.6	16.0	20.7
Biological sciences	9.4	15.5	21.5
Math/computer sciences	11.3	21.9	33.6
Computer sciences	13.6	29.0	39.4
Mathematics	9.2	13.2	31.1
Physical sciences	11.3	17.1	25.9
Chemistry	14.8	23.6	25.7
Earth, atm. & ocean.	5.2	9.7	16.8
Physics/astronomy	11.2	20.0	30.6
Social sciences	6.7	10.1	13.1
Economics	11.1	25.5	23.6
Political science	6.9	12.4	14.9
Psychology	5.9	6.1	9.0
Sociology/anthropology	4.4	13.1	14.4
Engineering	13.9	28.4	40.3
Chemical	17.0	32.5	38.6
Civil	17.3	36.4	50.6
Electrical/electronic	14.8	28.6	39.1
Mechanical	12.8	30.3	38.1
Non-S&E	6.8	7.7	12.4

NOTE: Data include all people residing in the United States at the time of the survey with a degree in science and engineering, regardless of where that degree was earned.

SOURCE: National Science Foundation, Science Resources Studies Division, 1993 National Survey of College Graduates.

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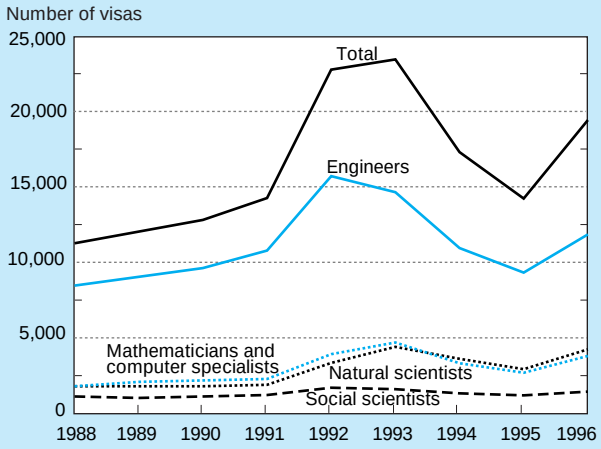
Figure 3-12.
Permanent visas issued to immigrant scientists and engineers



SOURCES: Immigration and Naturalization Service, <<http://www.ins.usdoj.gov/stats>>; and National Science Foundation, Science Resources Studies Division, *Nonacademic Scientists and Engineers: Trends From the 1980 and 1990 Censuses*, NSF 95-306 (Arlington, VA).

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visas to acquire permanent resident visas. In addition to these legislative acts, changes in procedures for visas led alternatively to surges and backlogs in applications. Aside from these short-term effects, there appears to have been little change in the growth of S&E immigration.

Stay Rates of Foreign Recipients of U.S. Ph.D.s

How many of the foreign students who receive S&E Ph.D.s from U.S. graduate schools stay in the United States? According to a report by Michael Finn (1997) of the Oak Ridge Institute for Science and Education, 47 percent of 1990-91 U.S. S&E doctorate recipients with temporary visas were still in the United States in 1995.[18] By field, this percentage ranged from 28 percent in the social sciences to 53 percent in engineering and the physical sciences. (See text table 3-17.) The overall stay rate for S&E doctoral visa-holders in 1995 was also 47 percent for the 1970-72 cohort.[19] The percentage of this cohort in the United States is stable over time, as 51 percent were in the United States in 1980 as well (Finn 1997). It is quite possible, however, that some of this stability comes from individuals in this cohort reentering the United States in mid-career, replacing others who leave the United States in mid-career. (For more information on this topic, see chapter 2, "Foreign Doctoral Students in the United States." For a discussion of the obverse phenomenon—emigration of U.S.-born Ph.D. recipients—see "How Many U.S. Scientists and Engineers Go Abroad?")

[18]These estimates were derived by matching records from NSF's Survey of Earned Doctorates to earnings records from the U.S. Social Security Administration. Statistical adjustments for limits to Social Security coverage were made by comparing against coverage rates for native-born doctorate-holders.

[19]Data from the NSF Survey of Earned Doctorates do not allow for distinctions between temporary and permanent visas from this period.

Text table 3-17.
Foreign recipients of U.S. Ph.D. degrees residing in the United States in 1995
(Percentages)

Ph.D. degree field	1990-91 Ph.D.s (temporary visas)	1970-72 Ph.D.s (temporary & permanent visas)
All S&E	47	47
Life sciences	45	36
Physical sciences and mathematics	53	57
Social sciences	28	30
Engineering	53	58

See appendix table 2-38.

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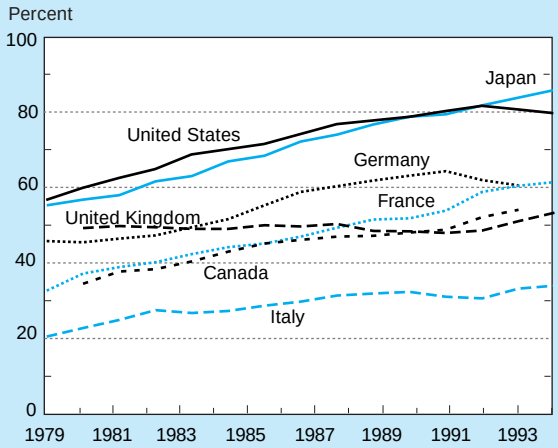
International R&D Employment

Japan continues to surpass the United States in terms of the proportion of the country's labor force comprised of R&D-performing scientists and engineers. (See figure 3-13.) Both countries lead the remaining G-7 nations (Germany, France, the United Kingdom, Italy, and Canada), although the U.S. share of total G-7 scientists and engineers engaged in R&D has fallen slightly—dropping from 48.0 percent in 1981 to 44.7 percent in 1993. (See figure 3-14.)

Figure 3-13.
Scientists and engineers engaged in R&D per 10,000 labor force, by country



NOTE: German data are for West Germany only before 1989.

See appendix table 3-15.

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How Many U.S. Scientists and Engineers Go Abroad?

In 1995, at least 19,600 U.S. native-born, naturalized citizen, and permanent resident Ph.D. scientists and engineers lived outside the United States.* (See text table 3-18.) These included:

- 3.3 percent (13,900) of native-born S&E doctorates,
- 7.4 percent (1,400) of foreign-born S&E doctorates with U.S. citizenship at time of degree, and
- 13.6 percent (4,300) of permanent residents at time of degree.

Not included are U.S. citizen Ph.D. scientists who had had only a temporary student visa or work visa when they received their Ph.D.; it may be reasonable to assume that this group is as likely to work outside the United States as those who had already been naturalized by the time of degree.

The likelihood of foreign residence for U.S. natives is greatest for those with the most recent degrees—ranging from 2.1 percent of 1945-54 native-born Ph.D. recipients to 3.4 percent of 1985-94 native-born Ph.D. recipients. By field, the proportion of native-born Ph.D.s resident in foreign countries is greatest in the mathematical and computer sciences and in the social sciences (4.2 percent for each). It is lowest in the physical sciences.

*Good estimates of the number of U.S. scientists and engineers who work abroad are not available, and the numbers presented here should be treated as lower bound estimates for several reasons. These estimates are based on a match of administrative data from the NSF 1995 Survey of Doctorate Recipients to individual data from the NSF Doctoral Record File created from the Survey of Earned Doctorates. The National Research Council (NRC) attempted to identify when a nonresponse was due to the sampled individual residing outside the United States as of the April reference date. To the extent that individuals residing outside the United States are more prevalent in the sample portion never located by NRC than they were in the located sample, these numbers will underestimate the extent of emigration. Note that, since a short-term trip abroad would not count as residence, and since the SDR data are collected over several months, there is little danger of miscategorizing a short absence as working abroad. There is, however, a somewhat greater danger of listing a person as living abroad who left the United States for many years and has since returned.

Text table 3-18.
Lower bound estimates of U.S. citizen and permanent resident Ph.D. graduates residing outside the United States: 1995

Ph.D. degree field	Native born		Foreign-born with citizenship at time of Ph.D.		Permanent resident at time of Ph.D.		Total citizen or permanent resident at time of Ph.D.	
	No.	% abroad	No.	% abroad	No.	% abroad	No.	% abroad
All S&E	13,900	3.3	1,400	7.4	4,300	13.6	19,600	4.1
Life sciences	3,400	2.7	200	5.0	900	12.0	4,500	3.3
Math and computer sciences	1,000	4.2	100	4.2	200	10.2	1,200	4.6
Physical sciences	2,200	2.5	300	8.7	800	12.6	3,200	3.3
Social sciences	5,900	4.2	300	7.5	1,200	18.0	7,400	4.9
Engineering	1,500	3.0	500	9.1	1,300	13.1	3,300	5.0

SOURCE: National Science Foundation, Science Resources Studies Division, Doctorate Record File and administrative records associated with collection of the 1995 Survey of Doctorate Recipients.

NOTE: Number and percent abroad data are estimated minimums.

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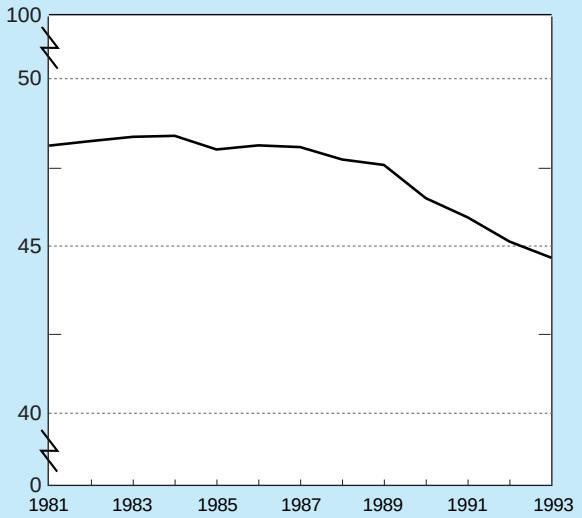
Projected Demand for S&E Workers[20]

During the 1996-2006 period, employment in S&E occupations is expected to increase at more than three times the rate for all occupations. While the economy as a whole is anticipated to provide approximately 14 percent more jobs over this decade, employment opportunities for S&E jobs are expected to increase by about 44 percent, or about 1.36 million jobs. (See figure 3-15.)

Approximately three-fourths of the increase in S&E jobs will occur in computer-related occupations. For a discussion of the labor market impacts resulting from the demand for employment in information technology-producing industries, see chapter 8, "IT and Employment." Overall employment in these occupations across all industries is expected to double over the 1996-2006 decade, with over 1 million new jobs being added. Jobs for computer engineers and scientists are expected to increase from 427,000 to 912,000, while employment for computer systems analysts is expected to grow from 506,000 to slightly over 1 million jobs.

[20]Data in this section are from U.S. BLS (1997).

Figure 3-14.
U.S. scientists and engineers engaged in R&D, as a percentage of the G-7 total



NOTE: G-7 nations are the United States, Japan, Germany, the United Kingdom, France, Canada, and Italy.

SOURCE: Organisation for Economic Co-operation and Development, Main Database (Paris: 1997).

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Within engineering, electrical/electronic engineering is projected to have the biggest absolute and relative employment gains, up by 105,000 jobs, or nearly 29 percent. Civil and mechanical engineers are also expected to experience above average employment gains, with projected increases of about 18 and 16 percent, respectively. Employment for all engineering occupations is expected to increase by an average of approximately 18 percent.

Job opportunities in life science occupations are projected to grow by almost 23 percent (41,000 new jobs) over the 1996-2006 period; at 24 percent, the biological sciences are expected to experience the largest growth (20,000 new jobs). Employment in physical science occupations is expected to increase by about 17 percent, from 207,000 to 242,000 jobs; about half of the projected job gains are for chemists (17,000 new jobs).

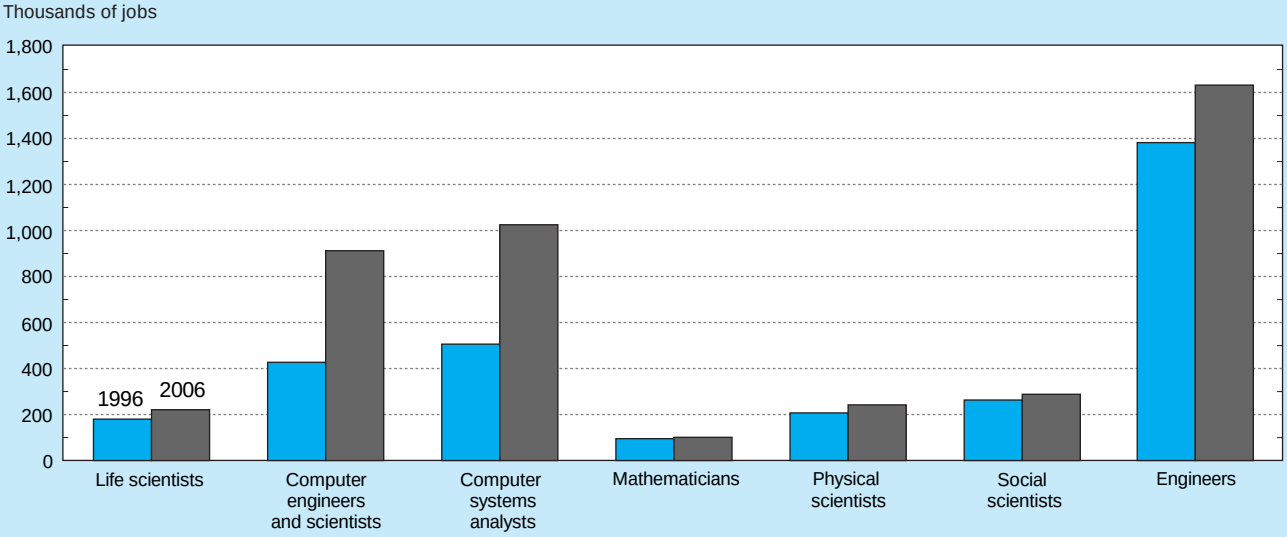
Social science occupations are expected to experience below average job growth (10 percent) over the decade, largely due to the modest employment increases anticipated for psychologists (8 percent, or 11,000 new jobs). Economists, however, are projected to experience more favorable job growth (18 percent, or 9,000 new jobs).

Conclusion

There were few changes in labor market conditions for scientists and engineers between 1993 and 1995, the most recent year for which comprehensive data are available. For Ph.D. scientists and engineers, the unemployment rate was essentially unchanged—moving from 1.6 to 1.5 percent. A similarly slight change held for recent S&E Ph.D. recipients, whose unemployment rate went from 1.7 to 1.9 percent and whose IOF rate increased from 4.0 to 4.3 percent. Unemployment rates across all S&E occupations were also low for bachelor's (2.1 percent) and master's (2.5 percent) degree level scientists and engineers.

While the vast majority of new Ph.D. scientists and engineers do find work that is relevant to their training, indicators of labor market difficulties exist in several fields. In physics,

Figure 3-15.
S&E jobs, by broad occupation: 1996 and projected 2006



See appendix table 3-16.

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unemployment rates for recent Ph.D.s have dropped to 2.9 percent, but the IOF proportion has increased to 6.7 percent, with placement in tenure-track positions at a historical low. For recent Ph.D. biological scientists, unemployment and IOF rates are low, but so is pay; and the drop in the percentage of tenure-track positions is the greatest of any field. Relative labor market difficulties also exist for recent Ph.D. graduates in political science; mathematics; sociology/anthropology; and the earth, atmospheric, and oceanographic sciences.

While postdoctoral appointments for additional training have become more prevalent over time in most S&E fields, labor market difficulties have stymied their increased use. Exceptions may include both physics—where multiple postdoctorate appointments are becoming more common than in the past—and the earth, atmospheric, and oceanographic sciences—where 29.3 percent of postdoctorates said they took their appointments primarily because other employment was not available.

The future of the S&E labor market is difficult to forecast for any number of practical reasons, but some indicators do exist. On the demand side, the U.S. Bureau of Labor Statistics predicts an increase in S&E jobs of 44 percent between 1996 and 2006—a growth rate three times faster than that for all occupations. The supply of individuals in the labor market with S&E degrees at all levels is likely to continue to increase even if there is no growth in degree production: current graduate numbers are much greater than the number of employed scientists now nearing traditional retirement ages. The same age structure of S&E workers suggests, however, that the number of scientists and engineers retiring will increase dramatically over the next 25 years even if the average retirement age increases.

While changes in earnings and unemployment rates are impossible to predict, on balance these factors suggest a future S&E labor force that is larger and older. Further, this labor force will generally be able to find employment that make use of its training, though not necessarily in tenured academic positions.

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